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Nichols et al.

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(54) **INTEGRATED FILTER SUPPORT**

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B01D 46/10 (2006.01)

(52) **U.S. Cl.**
CPC ***B01D 46/0005*** (2013.01); ***B01D 46/10*** (2013.01)

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USPC 55/490, 495, 385.2; 454/187
See application file for complete search history.

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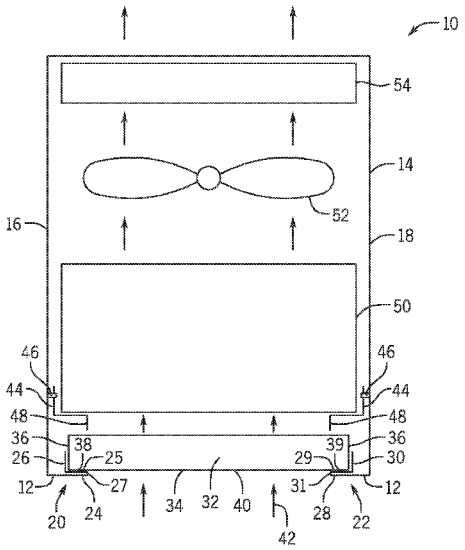
(57) **ABSTRACT**

The present disclosure relates to an air handling system including a casing structure formed from a cohesive sheet of material. The air handling system also includes a first side wall of the casing structure including a first section of the cohesive sheet of material. The air handling system also includes a first support portion extending inwardly from the first side wall. The first support portion includes a folded portion of the first side wall. The air handling system also includes a second side wall disposed substantially opposite the first side wall. The second side wall includes a second section of the cohesive sheet of material. The air handling system further includes a second support portion extending inwardly from the second side wall. The second support portion includes a folded portion of the second side wall. The first and second support portions are configured to support a filter.

20 Claims, 6 Drawing Sheets



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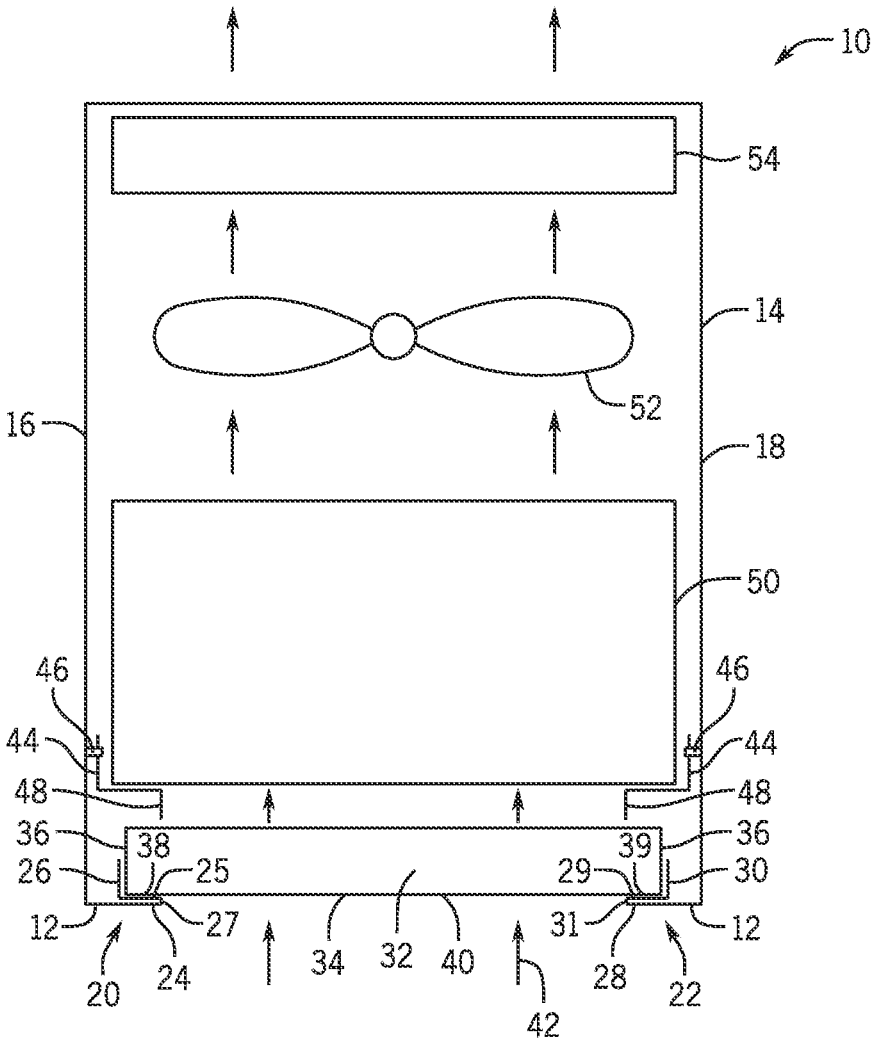
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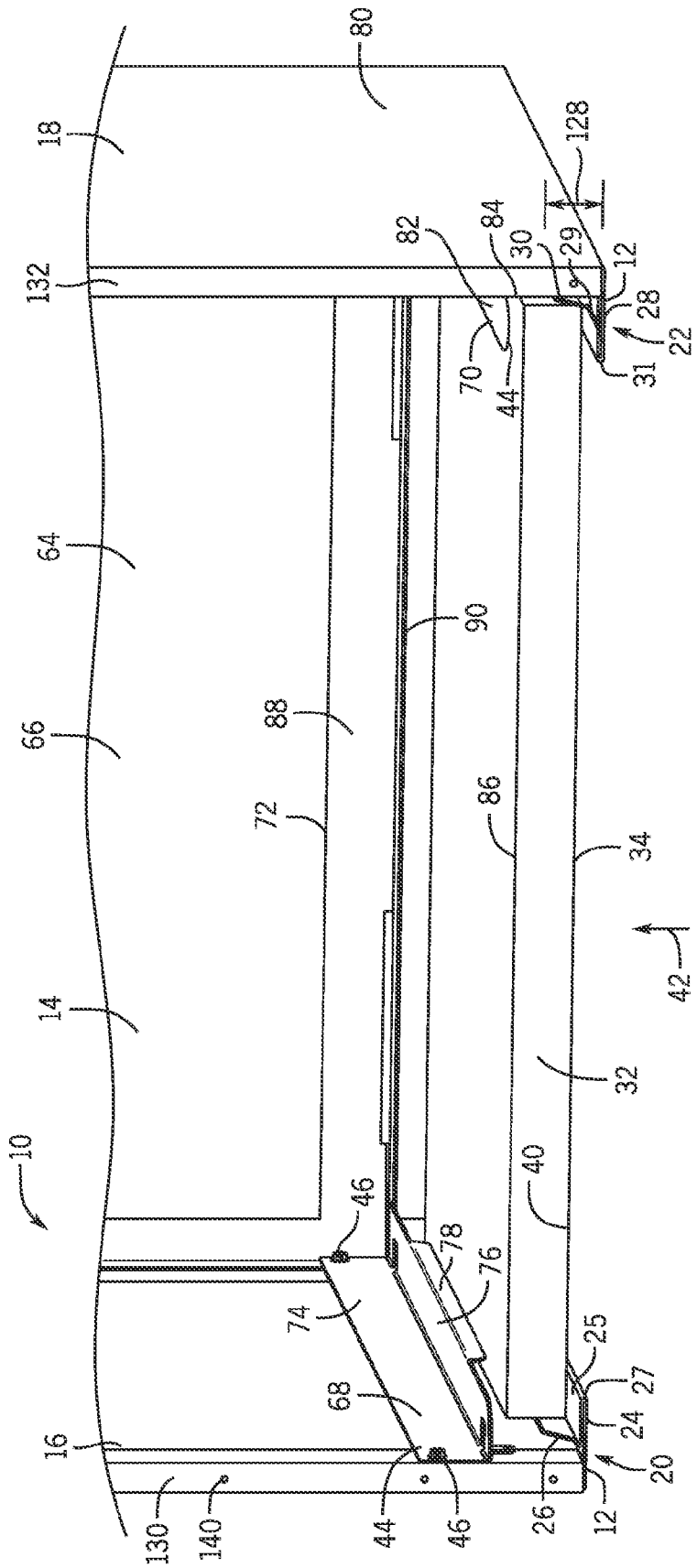
FIG. 1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26
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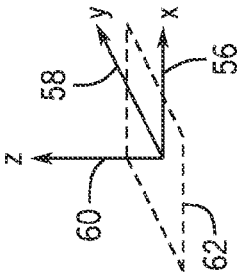
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56
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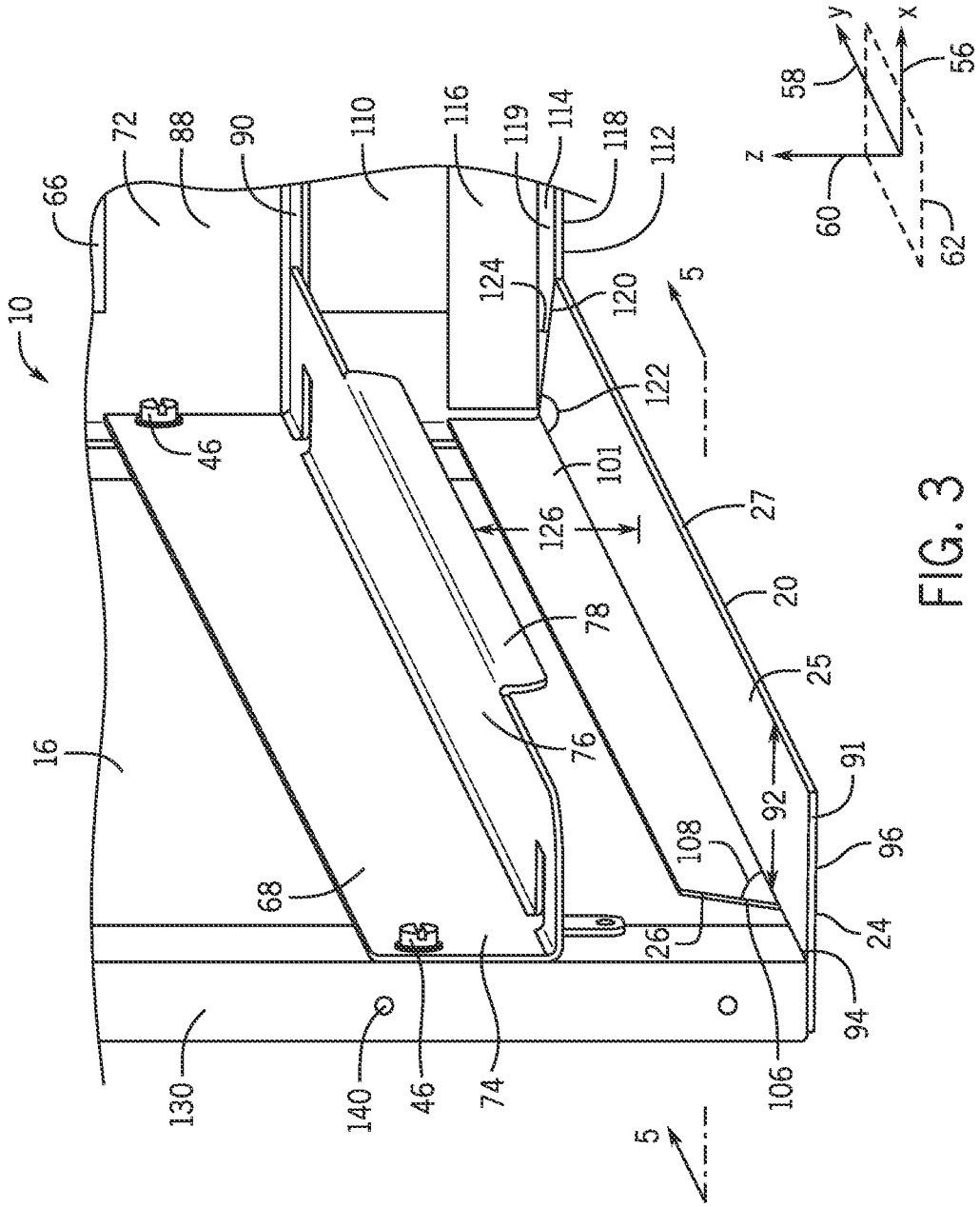
FIG. 2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92
108
96
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74
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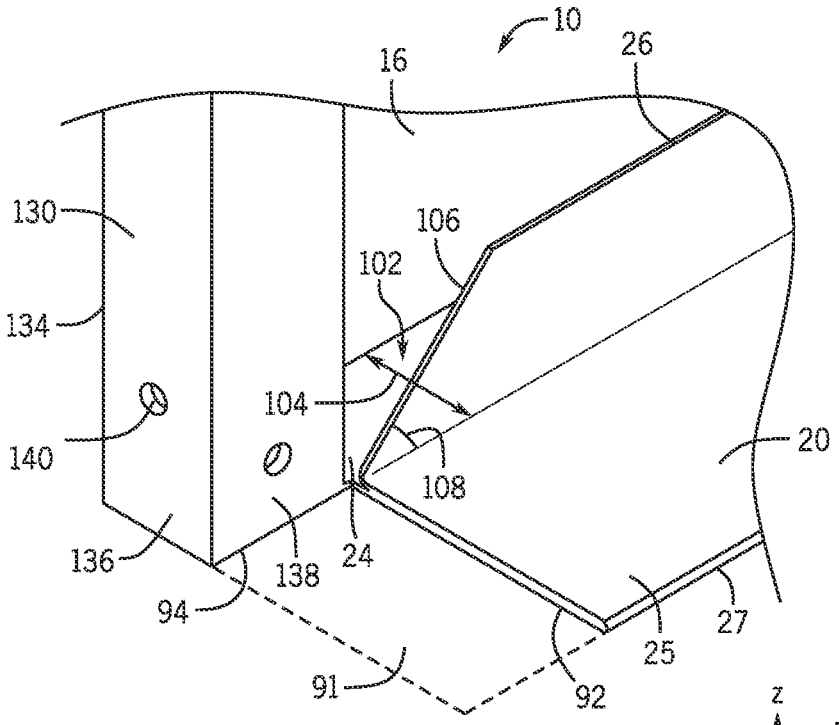
y
x

FIG. 3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16
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102
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138
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94
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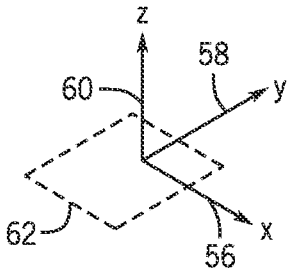
27
91
92

FIG. 4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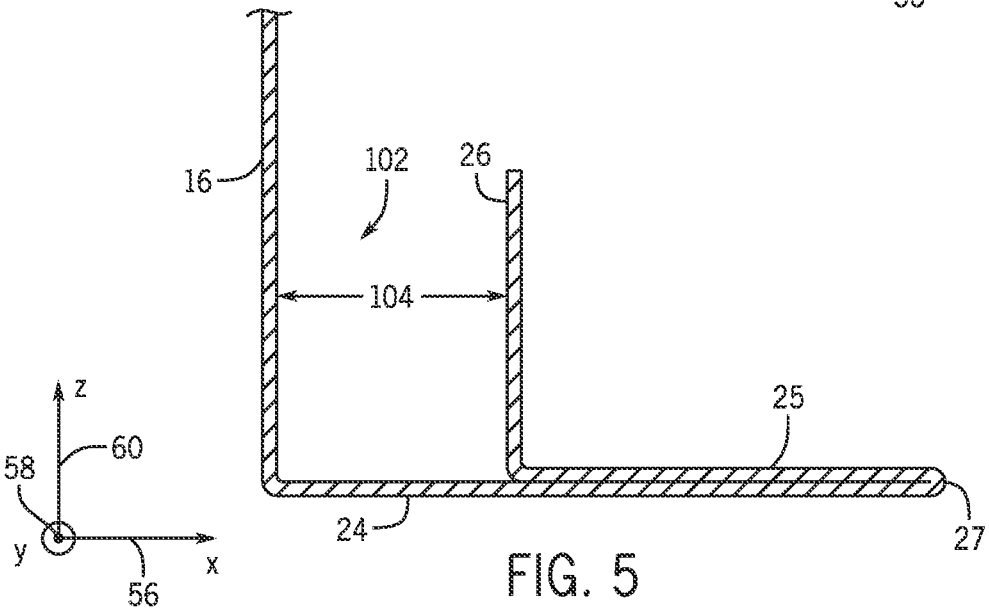
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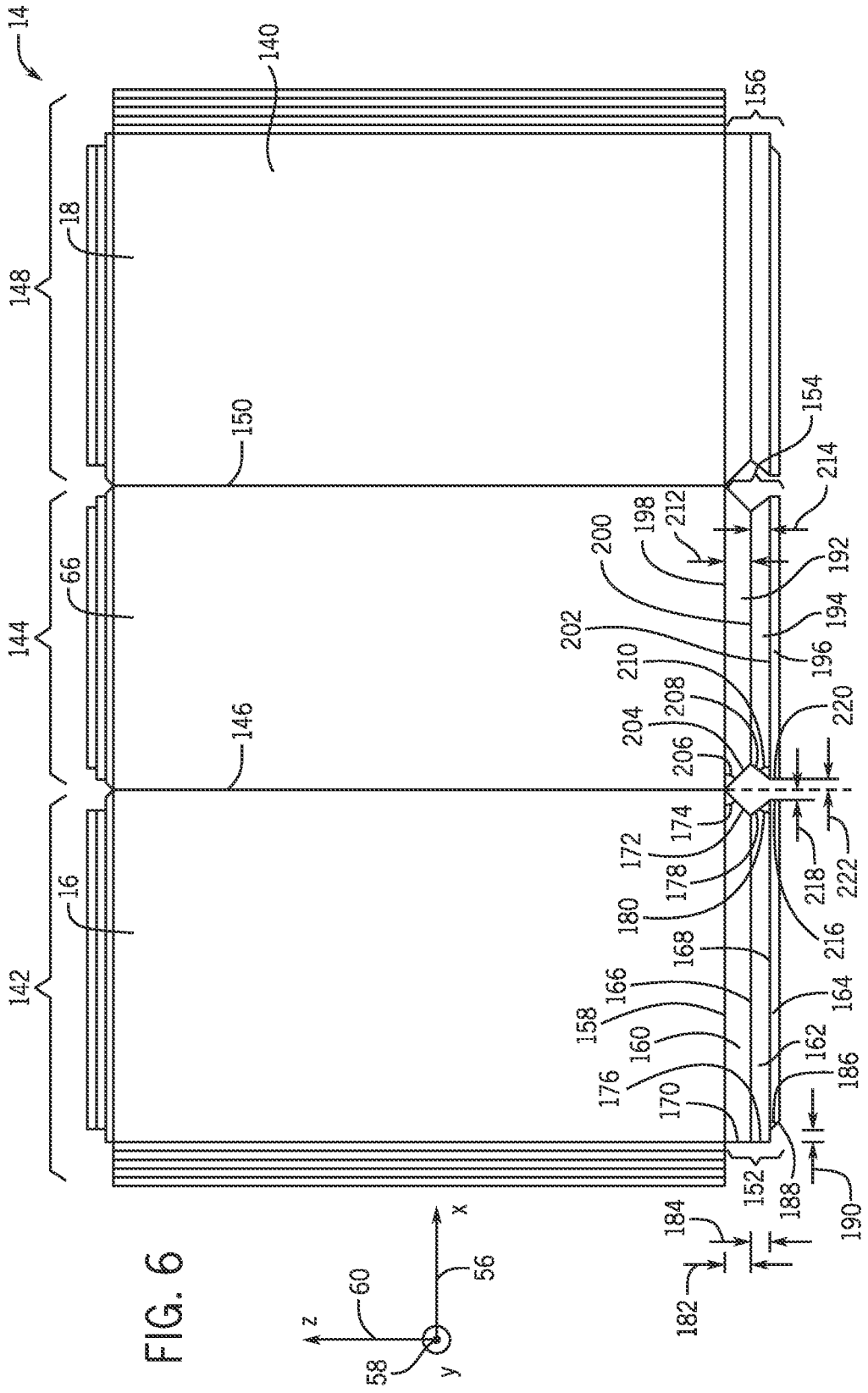
FIG. 5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178
218
222
16
180
216
168
142
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190
182
x
z
y
60
56
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FIG. 6

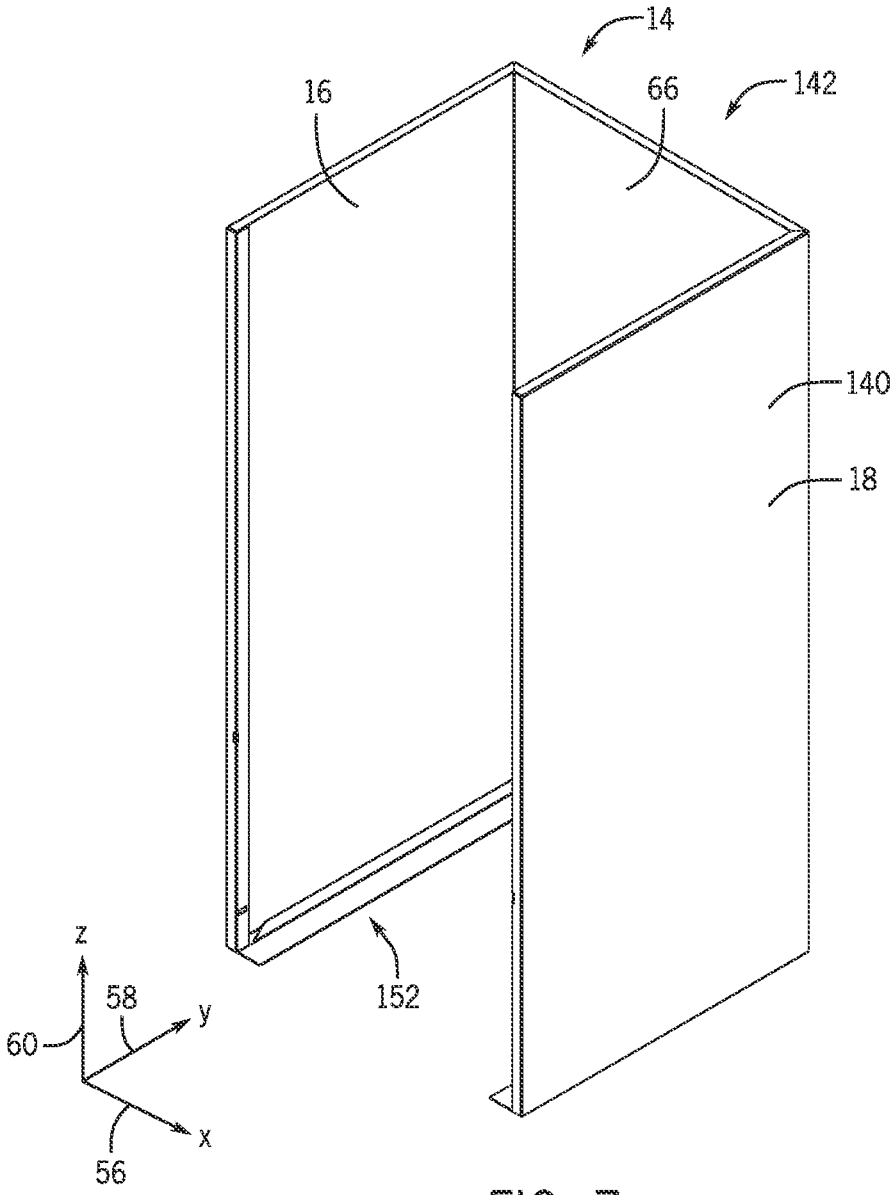

FIG. 7

INTEGRATED FILTER SUPPORT

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority from and the benefit of U.S. Provisional Application Ser. No. 62/048,750, filed Sep. 10, 2014, entitled "INTEGRATED FILTER SUPPORT," which is hereby incorporated by reference in its entirety for all purposes.

BACKGROUND

The present disclosure relates generally to air handling units and, more specifically, to integrated filter supports of air handling units.

Air handling units are widely used in Heating, Ventilation and Air Conditioning (HVAC) systems for the purposes of changing the thermal conditions of air and removing undesired particles and odors from the air. An air handling unit is typically designed to have a casing, within which various components are installed. For example, an air handling unit may typically include a heat exchanger and a fan for circulating the air to be conditioned in heat exchange relation with the heat exchanger.

An air handling unit may also typically include a filter, which is typically removable and replaceable, for screening undesired particles from the air flowing through the air handling unit. Accordingly, a filter support (e.g., rail, rack, bracket, drawer) may be attached to (e.g., screwed to or otherwise fastened to) the interior walls of the air handling unit casing for locating and supporting the filter.

SUMMARY

Embodiments of the present disclosure relate to an air handling system. The air handling system includes a casing structure formed from a cohesive sheet of material. The air handling system also includes a first side wall of the casing structure including a first section of the cohesive sheet of material. The air handling system also includes a first support portion extending inwardly from the first side wall. The first support portion includes a folded portion of the first side wall. The air handling system also includes a second side wall disposed substantially opposite the first side wall. The second side wall includes a second section of the cohesive sheet of material. The air handling system further includes a second support portion extending inwardly from the second side wall. The second support portion includes a folded portion of the second side wall. The first and second support portions are configured to support a filter.

Embodiments of the present disclosure also relate to a method of manufacturing a casing for an air handling system. The method includes bending a unified sheet to form a first side wall, a back wall, and a second side wall of the casing such that the back wall extends between and is substantially perpendicular with the first and second side walls. The method also includes folding a portion of the first side wall to form a first support portion extending inwardly from the first side wall. The method further includes folding a portion of the second side wall to form a second support portion extending inwardly from the second side wall. The first and second support portions are configured to support a filter.

Embodiments of the present disclosure also relate to an air handling system. The air handling system includes a casing formed from a solid sheet of material. The air handling system also includes at least three walls of the casing formed from portions of the solid sheet of material separated by creases that are formed substantially in parallel. The air handling system further includes edges of the walls that are folded to form projections extending inward relative to the casing. The projections are configured to cooperate to retain a filter within the casing.

DRAWINGS

FIG. **1** is a schematic block diagram of an air handling unit including a filter support integral with wall portions in accordance with an embodiment of the present disclosure;

FIG. **2** is a perspective view of a portion of an air handling unit including a filter support in accordance with an embodiment of the present disclosure;

FIG. **3** is a magnified perspective view of the portion of the air handling unit including the filter support of FIG. **2**;

FIG. **4** is a further magnified perspective view of the portion of the air handling unit including the filter support of FIG. **2**;

FIG. **5** is a cross-sectional view of the filter support of FIG. **4**;

FIG. **6** is a top view of an extended or unfolded air handling unit casing in accordance with an embodiment of the present disclosure; and

FIG. **7** is a perspective view of a folded air handling unit casing in accordance with an embodiment of the present disclosure.

DETAILED DESCRIPTION

The present disclosure is directed to an integrated filter support that is a part of an air handing unit casing. In accordance with an embodiment of the present disclosure, the air handing unit casing is formed from a single cohesive sheet of material (e.g., metal, polymer, or carbon fiber), a part of which may be folded to form walls and a filter support. By making the filter support from integral features of the air handling unit casing, the material and labor for fabricating a separate filter support may be reduced or eliminated, and the labor for installing the separate filter support into the air handling unit casing may also be reduced or eliminated. Although the integrated filter support is described herein in the context of an air handing unit, it should be noted that the integrated filter support may have like applicability in any cabinet-type device where it is desired to hold a filter element.

With the foregoing in mind and turning to the figures, FIG. **1** illustrates schematically an air handling unit **10** including a filter support **12** in accordance with an embodiment of the present disclosure. The air handling unit **10**, as illustrated, is positioned in a vertical orientation or manner (e.g., air may flow vertically through the air handling unit **10**) and will be described accordingly. However, it should be noted that the air handling unit **10** may be positioned in a horizontal manner or any other suitable manner, and the filter support **12** in accordance with the present disclosure may be likewise applied to the air handling unit **10** positioned in other orientations or manners.

The air handling unit **10** includes a casing (or housing, wrapper) **14** forming two side walls (e.g., a first side wall **16** and a second side wall **18**) and a rear wall, as discussed in greater detail below. A cabinet cover (initially separate from the casing **14**) may be placed over the front of the air handling unit **10** as a door or front wall to complete an enclosure of the air handling unit **10**. In some embodiments,

the casing **14** may also form a front wall without using a separate cover or door. The enclosure may physically separate the conditioned and circulated air inside the air handling unit **10** from the air in the surrounding environment and provide a protective cover for various components of the air handling unit **10** disposed within the enclosure. Air **42** may flow through the air handling unit **10** generally from the bottom to the top of the air handling unit **10**.

The air handling unit **10** includes the filter support **12** located at the bottom of the air handling unit **10**. The filter support **12**, in accordance with the present disclosure, is formed from the casing **14**, thereby making it an integrated part of the casing **14**. For example, the filter support **12** includes a first support portion **20** and a second support portion **22** formed by folding or bending the edges of the first side wall **16** and the second side wall **18**, respectively, inwardly at the bottom of the air handling unit **10**. As will be discussed in greater detail below, the first support portion **20** may include multiple folds of the edge of the first side wall **16**. A first fold forms a first base portion **24** of the first support portion **20**. The first base portion **24** extends inwardly from the first side wall **16**. A second fold forms a first upper ledge **25** of the first support portion **20**. The first upper ledge **25** extends outwardly toward the first sidewall **16** from an innermost edge **27** of the first base portion **24**. A third fold forms a first flange **26** of the first support portion **20**. The first flange **26** extends upwardly from the first upper ledge **26**. Likewise, the second support portion **22** of the filter support **12** may include a second base portion **28** (with an innermost edge **31**), a second upper ledge **29**, and a second flange **30**.

The first support portion **20** and the second support portion **22** of the filter support **12** are configured to support or hold a filter **32**. For example, the first base portion **24** and the second base portion **28** may support or hold the bottom side **34** (e.g., portions of the bottom side **34** proximate two sides **36**) of the filter **32**. As illustrated, the first support portion **20** and the second support portion **22** may cover or abut portions **38**, **39**, respectively, of the bottom side **34** of the filter **32** by virtue of supporting or holding the filter **32**, while leaving another portion **40** of the bottom side **34** of the filter **32** uncovered. With this uncovered portion **40**, the air **42** may flow through the filter **32** into the air handling unit **10**. The filter **32** is configured to remove particles from the air **42** as the air **42** flows through the filter **32** and may be any type of filter suitable for removal of particles from the air **42**. The filter **32** is also disposed horizontally between the first flange **26** and the second flange **30** such that the horizontal movement of the filter **32** is limited. In some embodiments, the filter support **12** may additionally include a third support portion, similar to the first support portion **20** and the second support portion **22**, that is formed by folding or bending the edge of the rear wall of the casing **14**. This additional support portion, together with the first support portion **20** and the second support portion **22**, may be configured to support or hold the filter **32**.

One or more side angles **44** may be attached to interior walls (e.g., interior side of the casing **14**) of the air handling unit **10**, for example, with one or more fasteners **46**. The one or more side angles **44** are positioned above the filter support **12** and may each include an elongated tooth portion **48** positioned generally vertically. The filter **32** is disposed in between the one or more tooth portions **48** of side angles **44** and the filter support **12** such that the vertical movement of the filter **32** is limited. In some embodiments, the side angles **44** (and the tooth portions **48**) may also be integral with and formed from the casing **14**. In such embodiments, the side angles **44** are formed in a similar manner to the support portions **20**, **22**, for example, by folding some portions of the support portions **20**, **22** to extend further upwardly and then inwardly.

The air handling unit **10** also includes a heat exchanger **50** disposed above the filter **32**, for example, on the one or more side angles **44**. The heat exchanger **50** may include one or more coils, within which a refrigerant may flow through to exchange heat with the air **42** as the air **42** flows through the heat exchanger **50**. To facilitate the flow of the air **42** through the air handling unit **10**, the air handling unit **10** may include one or more fans **52**. The one or more fans **52** may draw the air **42** through the heat exchanger **50** and discharge the air **42** upwardly through the top of the air handling unit **10**. An electric resistance heater **54** may also be included in (e.g., at the top of) the air handling unit **10** for adding heat energy to the air **42**.

FIG. **2** is a perspective view of a portion of the air handling unit **10** including the filter support **12** in accordance with an embodiment of the present disclosure. Axes **56**, **57**, and **58** are utilized to describe directions relative to the air handling unit **10**, where the x-axis **56** and the y-axis **58** lie in a horizontal plane **62**, and the z-axis **60** extends in a vertical direction perpendicular to the horizontal plane **62**. The air handling unit **10** includes the casing **14**. The casing **14** is formed from a cohesive sheet of material **64** (e.g., a single, unified sheet of metal), as discussed in greater detail below. For example, the cohesive sheet of material **64** may be bent or folded to form two side walls (e.g., the first side wall **16** and the second side wall **18**) and a rear wall **66**. The rear wall **66** extends between and is substantially perpendicular with the first side wall **16** and the second side wall **18**. A cabinet cover (e.g., door or panel) may be placed over the front to complete the enclosure of the air handling unit **10**. For example, the cabinet cover may be hingedly coupled to the first and/or second side wall **16**, **18** to provide a door.

As illustrated, the filter support **12** includes the first support portion **20** and the second support portion **22**. The first support portion **20** is part of the first side wall **16** and formed by bending the edge of the first side wall **16** inwardly (e.g., along x-axis **56**). Likewise, the second support portion **22** is part of the second side wall **18** and formed by bending the edge of the second side wall **18** inwardly (e.g., along x-axis **56**). The first support portion **20** and the second support portion **22** are substantially perpendicular to the first side wall **16** and the second side wall **18**, respectively, and configured to support or hold the filter **32**.

The first support portion **20** and the second support portion **22** cover (e.g., abut) the portions **38**, **39**, respectively, of the bottom side **34** of the filter **32** by virtue of supporting the filter **32**. The air may flow through the filter **32** via the uncovered portion **40** of the bottom side **34** of the filter **32**. The covered portions **38**, **39** and the uncovered portions **40** may have any suitable sizes (or the ratio of the size of one portion to another) depending on the design of the air handling unit **10**. By way of example, the size of each of the covered portions **38**, **39** is less than approximately 100%, such as approximately 90%, 80%, 70%, 60%, 50%, 40%, 30%, 20%, 15%, 10%, 5%, or 1% of the size of the uncovered portion **40**.

To facilitate limiting the vertical movement (e.g., along the z-axis **60**) of the filter **32**, the air handling unit **10** includes the one or more side angles **44** attached to the interior walls of the air handling unit **10** above the filter support **12**. As indicated above, the side angles **44** may also be formed from the casing **14**. As illustrated, each of the one or more side angles **44** include a first side angle **68** attached

to the first side wall **16**, a second side angle **70** attached to the second side wall **18**, and a third side angle **72** attached to the rear wall **66**. Each of the side angles **44** (e.g., **68**, **70**, **72**) may be attached to the respective wall with the one or more fasteners **46** (e.g., screws, adhesive features, welds).

The side angles **44** (e.g., **68**, **70**, **72**) may have the same or different configurations with one another. For example, in the illustrated embodiment, the first side angle **68** has the same configuration as the second side angle **70** but different configuration from the third side angle **72**. More specifically, the first side angle **68** includes a first angle base **74** and a first angle flange **76**. The first angle base **74** is attached to the first side wall **16** with the one or more fasteners **46**. The first angle flange **76** is substantially perpendicular to the first angle base **74** and extends inwardly from the first side wall **16**. The first angle flange **76** includes a first elongated tooth portion **78** formed by bending all or a portion of the first angle flange **76** downwardly therefrom. Likewise, the second side angle **70** includes a second angle base **80** and a second angle flange **82**, the latter of which may include a second elongated tooth portion **84**. The tooth portions (e.g., the first tooth portion **78** of the first side angle **68** and the second tooth portion **84** of the second side angle **70**) are in direct contact with, or proximate to, a top side **86** of the filter **32** when the filter **32** is installed. As such, the filter **32** may be positioned below the first side angle **68** and the second side angle **70**, and above the first support portion **20** and the second support portion **22**, thereby being limited in vertical movements (along the z-axis **60**). In some embodiments, the first and second angle flanges **76**, **82** do not include any tooth portions, and accordingly, the first and second angle flanges **76**, **82** may be in direct contact with, or proximate to, the top side **86** of the filter **32** to limit the vertical movements (along the z-axis **60**) of the filter **32**.

In the illustrated embodiment, the third side angle **72** includes a third angle base **88** and a third angle flange **90**, the latter of which does not include any tooth portion. In certain embodiments, the third angle flange **90** may include an elongated tooth portion similar to the first tooth portion **78**. The third angle base **88** is attached to the rear wall **66**, and the third angle flange **90** is substantially perpendicular to the third angle base **88** and extends inwardly from the rear wall **66**.

The one or more side angles **44** (e.g., the first, second, and third side angles **68**, **70**, **72**) are also configured to provide support for other components of the air handling unit **10**. For example, the first, second, and third angle flanges **76**, **82**, **90** are substantially co-planar (e.g., on the horizontal plane **62**) such that they may hold a supporting structure (e.g., plate, drawer, or panel) thereabove for supporting other components of the air handling unit **10**, or hold or support directly thereabove other components of the air handling unit **10**. In certain embodiments where the air handling unit **10** includes only two side angles (e.g., the first and the second side angles **68**, **70**), the first and second angle flanges **76**, **82** may be substantially co-planar (e.g., on the horizontal plane **62**) for supporting other components of the air handling unit **10** as well as for limiting the vertical movements of the filter **32** (e.g., with the tooth portions **78**, **84**). In the illustrated embodiment, the angle bases **74**, **80**, **88** extend above the angle flanges **76**, **82**, **90**. In other embodiments, the angle bases **74**, **80**, **88** extend beneath the angle flanges **76**, **82**, **90**.

FIGS. **3** and **4** are magnified views of the portion of the air handling unit **10** of FIG. **2**. FIG. **3** focuses on the first support portion **20** of the filter support **12** and the first side angle **68**. FIG. **4** is a further magnified view of the first support portion **20** of the filter support **12** of FIG. **3**. In addition, in FIG. **4**, a corner piece **91** of the first support portion **20**, along lines **92**, **94** indicated in FIG. **3**, is removed from the rest of the first support portion **20** for illustrative purposes. The line **92** is along the x-axis **56** and substantially parallel to a front edge **96** of the first support portion **20**. The line **94** is along the y-axis **58** and substantially parallel to the first side wall **16**.

As illustrated in FIGS. **3** and **4**, the first support portion **20** includes multiple folds of the edge of the first side wall **16**. A first fold forms the first base portion **24** by folding the bottom edge of the first side wall **16** inwardly therefrom. The first base portion **24** is substantially perpendicular to the first side wall **16**. For example, the first side wall is on a plane defined by the y-axis **58** and the z-axis **60**, and the first base portion **24** is substantially on the plane **62**. The first base portion **24** extends from the first side wall along the positive x-axis **56**.

A second fold continues from the first fold to form the first upper ledge **25** by extending outwardly toward the first side wall **16** from the innermost edge **27** of the first fold. For example, the first upper ledge **25** extends from the innermost edge **27** of the first base portion **24** along the negative x-axis **56**. The first upper ledge **25** may provide support for the filter **32** when the filter **32** is placed above the first upper ledge **25**. In the illustrated embodiment, the first upper ledge **25** is on top of (e.g., in direct contact with) the first base portion **24**. In some embodiments, the first upper ledge **25** may be above and without contacting the first base portion **24**, for example, there is a gap between the first upper ledge **25** and the first base portion **24**.

A third fold continues from the second fold to form the first flange **26** by extending upwardly from the second fold. For example, the first flange **26** extends from the first upper ledge **25** along the positive z-axis **60**, with a crease **101** joining the first flange **26** and the first upper ledge **25**. As such, the first flange **26** is substantially perpendicular to the first upper ledge **25** and parallel to the first side wall **16**. The first flange **26** may provide a left barrier or block to limit the horizontal movements (e.g., along the negative x-axis **56**) of the filter **32** when the filter is placed above the first upper ledge **25**. A gap **102** is formed between the first flange **26** and the first side wall **16** with a length **104** along the x-axis **56**. The gap **102** may be filled with one or more thermal insulation materials to reduce heat exchange between the air inside of the air handling unit **10** and the environment. In some embodiments, the first flange **26** may include a slanted edge **106**. For example, an angle **108** between the slanted edge **106** and the crease **101** may be less than approximately 90 degrees, such as approximately 80 degrees, 75 degrees, 60 degrees, 50 degrees, 45 degrees, 40 degrees, 30 degrees, 25 degrees, 15 degrees, or 5 degrees. The slanted edge **106** may provide ready access to the filter **32** when changing or replacing the filter **32**.

Although the first support portion **20** of the filter support **12** is described herein in detail, it should be noted that the second support portion **22** of the filter support **12** may be formed and described similarly. For example, the second support portion **22** is formed by extending the bottom edge of the second side wall **18**. The second support portion **22** likewise includes multiple consecutive folds, for example, a first fold to form the second base portion **28**, a second fold to form the second upper ledge **29**, and a third fold to form the second flange **30**. The second base portion **28** extends inwardly (e.g., along negative x-axis **56**) from the second side wall **18**, the second upper ledge **29** extends outwardly (e.g., along positive x-axis **56**) from the innermost edge **31** of the second base portion **28**, and the second flange **30**

extends upwardly (e.g., along positive z-axis **60**) from the second upper ledge **29**. The second upper ledge **29** may provide support for the filter **32** when the filter is placed above the second upper ledge **29**, and the second flange **30** may provide a right barrier or block to limit the horizontal movements (e.g., along the positive x-axis **56**) of the filter **32**. The first upper ledge **25** and the second upper ledge **29** (or the first base portion **24** and the second base portion **28**) may be substantially co-planar (e.g., on the horizontal plane **62**) such that the filter **32** may be placed above the first upper ledge **25** and the second upper ledge **29** in a substantially horizontal manner (e.g., on the horizontal plane **62**).

As illustrated in FIG. **3**, the filter support **12** also includes a third support portion **110**. Similar to the first and second support portions **20**, **22**, the third support portion **110** is formed by folding or bending the bottom edge of the rear wall **66**. The third support portion **110** likewise includes multiple consecutive folds, for example, a first fold to form the third base portion **112**, a second fold to form the third upper ledge **114**, and a third fold to form the third flange **116**. The third base portion **112** extends inwardly (e.g., along negative y-axis **58**) from the rear wall **66**, the third upper ledge **114** extends outwardly (e.g., along positive y-axis **58**) from an innermost edge **118** of the third base portion **112**, and the third flange **116** extends upwardly (e.g., along positive z-axis **60**) from the third upper ledge **114** with a crease **119** therebetween. The third upper ledge **114** may provide support for the filter **32** when the filter is placed above the third upper ledge **114**, and the third flange **116** may provide a rear barrier or block to limit the horizontal movements (e.g., along the positive y-axis **58**) of the filter **32**. A gap may be formed between the third flange **116** and the rear wall **66** (e.g., along the y-axis **58**) and filled with one or more thermal insulation materials to reduce heat exchange between the air inside of the air handling unit **10** and the environment.

In the illustrated embodiment of FIG. **3**, the first upper ledge **25** and the third upper ledge **114** are substantially co-planar (e.g., on the horizontal plane **62**). The first upper ledge **25** and the third upper ledge **114**, as well as the first base portion **24** and the third base portion **112**, join together substantially seamlessly about a line **120**. The line **120** forms a first angle **122** with the crease **101** and a second angle **124** with the crease **119**. Because the first side wall **16** is substantially perpendicular to the rear wall **66**, the sum of the first angle **122** and the second angle **124** is substantially 90 degrees. For example, the first angle **122** is less than approximately 90 degrees, such as approximately 80 degrees, 70 degrees, 60 degrees, 50 degrees, 45 degrees, 40 degrees, 30 degrees, 20 degrees, or 10 degrees. Correspondingly, the second angle **124** is less than approximately 90 degrees, such as approximately 10 degrees, 20 degrees, 30 degrees, 40 degrees, 45 degrees, 50 degrees, 60 degrees, 70 degrees, or 80 degrees. Similarly, the third upper ledge **114** and the second upper ledge **29** of the second support portion **22** are substantially co-planar (e.g., on the horizontal plane **62**) and join together substantially seamlessly with the same or similar configurations (e.g., joining angles similar to the first and second angles **122**, **124**). The substantially co-planar (e.g., on the horizontal plane **62**) first, second, and third upper ledges **25**, **29**, **114** may provide support for the filter **32** in a substantially horizontal manner. In some embodiments, the filter support **12** may not include the third support portion **110**, or the third upper ledge **114** may not be substantially co-planar with the first and second upper ledges **25**, **29**. In these embodiments, the first upper ledge **25** and the second upper ledge **29** may be substantially co-planar (e.g., on the horizontal plane **62**) such that the filter **32** may be placed above the first upper ledge **25** and the second upper ledge **29** in a substantially horizontal manner (e.g., on the horizontal plane **62**) and below the third support portion **110**. Also, the third support portion **110** may be excluded.

As discussed above, the vertical movements (e.g., along the z-axis **60**) of the filter **32** may be limited by one or more side angles **44** (e.g. the first, second, and third side angles **68**, **70**, **72**) disposed above the filter support **12**. FIG. **3** illustrates the first side angle **68** with a closer view. As illustrated, the first angle flange **76** includes one elongated first tooth portion **78** formed by bending a portion of the first angle flange **76** downwardly (e.g., along the negative z-axis **60**) therefrom. It should be noted that the first angle flange **76** may include any number of the first tooth portion **78**, such as 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, or the like. A distance **126** along the z-axis **60** between the bottom tip of the first tooth portion **78** and the first upper ledge **25** may be configured to accommodate a height **128** (along the z-axis **60**, shown in FIG. **2**) of the filter **32**. The distance **126** is approximately the same or greater than the height **128** of the filter **32** such that the filter **32** may fit in between the first tooth portion **78** and the first upper ledge **25**, and the vertical movements (e.g., along the z-axis **60**) of the filter **32** may also be limited to a desired degree. The second and third side angles **70**, **72** may include the similar tooth portions. In certain embodiments where the side angles **44** do not include any tooth portion, the angle flanges (e.g., the first, second, or third angle flanges **76**, **82**, **90**) may be in direct contact with, or proximate to, the top side **86** of the filter **32** to limit the vertical movements (along the z-axis **60**) of the filter **32**.

Also as illustrated in FIGS. **2-4**, the casing **14** of the air handling unit **10** may be folded or bent to form one or more front posts. For example, the front edge of the first side wall **16** may be folded or bent via one or more folds to form a first front post **130**. The front edge of the second side wall **18** may be folded or bent via one or more folds to form a second front post **132**. Depending on the number of folds, each of the first and second front posts **130**, **132** may include two or more sides. For example, as illustrated in FIG. **4**, the first front post **130** includes three sides. A first side **134** is the first side wall **16**. A second side **136** extends from and is substantially perpendicular to the first side **134**. A third side **138** extends from and is substantially perpendicular to the second side **136**. Each of the one or more front posts (e.g., the first and second front posts **130**, **132**) may include one or more holes **140** for coupling other components of the air handling unit **10** to the respective front posts. For example, a front panel or door may be coupled to (e.g., screwed onto, or hinged to) the casing **14** via the one or more holes **140** of the one or more front posts.

FIG. **5** is a cross-sectional view of the first support portion **20** of the filter support **12** taken from line **5-5** of FIG. **3**. As illustrated, the first support portion **20** is an integrated part of the first side wall **16** and formed by folding the bottom edge of the first side wall **16** via multiple folds. The first fold forms the first base portion **24** by folding the bottom edge of the first side wall **16** inwardly along the positive x-axis **56**. The first base portion **24** is substantially perpendicular to the first side wall **16**. The second fold continues from the first fold to form the first upper ledge **25** by extending outwardly (e.g., along the negative x-axis **56**) toward the first side wall **16** from the innermost edge **27** of the first fold. The first upper ledge **25** is on top of (e.g., in direct contact with) the first base portion **24**. The third fold continues from the second fold to form the first flange **26** by extending

upwardly (e.g., along the positive z-axis **60**) from the second fold. The first flange **26** is substantially perpendicular to the first upper ledge **25** and parallel to the first side wall **16**. The gap **102** is formed between the first flange **26** and the first side wall **16** with the length **104** along the x-axis **56**.

As discussed above, the filter support **12**, in accordance with the present disclosure, is an integrated part of the casing **14** and may be formed by bending or folding the edges of the casing **14**. Therefore, the filter support **12** may be manufactured as an integrated part of manufacturing the casing **14** for the air handling unit **10**. FIG. **6** is a top view of the casing **14** in an extended configuration (e.g., on the plane defined by the x-axis **56** and the z-axis **60**) formed from a unified or cohesive sheet **140**. FIG. **7** is a perspective view of the casing **14** that is folded from the extended configuration in FIG. **6** to form an enclosure **142** of the air handling unit **10**. The cohesive sheet **140** may be fabricated from any material suitable for enclosing the air handling unit **10** and bending to form the casing **14**, including, but not limited to, metal, polymer, carbon fiber, or the like. The cohesive sheet **140** may be cut or otherwise fabricated to have a profile or boundary such as the profile of the casing **14** illustrated in FIG. **6**. Slits may be cut along creases to facilitate bending.

The cohesive sheet **140** may be folded or bent to form different sections of the casing **14** and the filter support **12**. The cohesive sheet **140** includes multiple creases, about which various sections of the cohesive sheet **140** may be folded or bent with respect to one another. For example, a first section **142** of the cohesive sheet **140** borders a second section **144** about a crease **146**, and the second section **144** borders a third section **148** about a crease **150**. The first section **140** may be bent towards the second section **144** (e.g., towards the negative y-axis **58**) to be substantially perpendicular to the second section **144**. The third section **148** may also be bent towards the second section **144** (e.g., towards the negative y-axis **58**) to be substantially perpendicular to the second section **144**. As such, the first section **142** of the cohesive sheet **140** may form the first side wall **16** of the casing **14**, the third section **148** of the cohesive sheet **140** may form the second side wall **16** of the casing **14**, and the second section **144** the of the cohesive sheet **140** may form the rear wall **66** of the casing **14**, as illustrated in FIG. **7**.

The first section **142** of the cohesive sheet **140** about the bottom edge includes a first bottom edge section **152**. Similarly, the second section **144** of the cohesive sheet **140** about the bottom edge includes a second bottom edge section **154**, and the third section **148** of the cohesive sheet **140** about the bottom edge includes a third bottom edge section **156**. The first bottom edge section **152** may be folded to form the first support portion **20** of the filter support **12**, the third bottom edge section **156** may be folded to form the second support portion **22** of the filter support **12**, and the second bottom edge section **154** may be folded to form the third support portion **110** of the filter support **12**.

Using the first bottom edge section **152** as an example, a method is described herein to illustrate the formation of the first support portion **20** of the filter support **12** from the first section **142** of the cohesive sheet **140**. The first bottom edge section **152** borders the rest of the first section **142** about a crease **158**. The first bottom edge section **152** includes three folds: a first edge fold **160**, a second edge fold **162**, and a third edge fold **164**. The first edge fold **160** borders the second edge fold **162** about a crease **166**, and the second edge fold **162** borders the third edge fold **164** about a crease **168**. As such, the first bottom edge section **152** may be folded in a boustrophedonic orientation (e.g., about the creases **158**, **166**, **168**). For example, as discussed above (e.g., with respect to FIG. **5**), the first edge fold **160** may be folded about the crease **158** inwardly from and substantially perpendicular to the first side wall **16** to form the first base portion **24** of the first support portion **20**. The second edge fold **162** may be folded about the crease **166** outwardly towards the first side wall **16** and on top of the first edge fold **160** to form the first upper ledge **25** of the first support portion **20**. The third edge fold **164** may be folded about the crease **168** upwardly and substantially parallel to the first side wall **16** to form the first flange **26** of the first support portion **20**. Similar to the first bottom edge section **152**, the second bottom edge section **154** and the third bottom edge section **156** may each have three folds that may be folded in a boustrophedonic orientation to form the third support portion **110** and the second support portion **22**, respectively, of the filter support **12**.

As illustrated, the first edge fold **160** includes a left side **170**, substantially perpendicular to the crease **158**, and a right side **172**, forming an angle **174** (e.g., the angle **122** as illustrated in FIG. **3**) with the crease **158** less than approximately 90 degrees. The second edge fold **162** includes a left side **176**, substantially perpendicular to the creases **166**, **168**, and a right side **178**, forming an angle **180** with the crease **168**. The angle **180** is substantially the same as the angle **174** such that when the first and second edge folds **160**, **162** are folded as discussed above, the right side **172** of the first edge fold **160** and the right side **178** of the second edge fold **162** are substantially aligned. In addition, the left side **170** of the first edge fold **160** has a length **182** that is greater than a length **184** of the left side **176** of the second edge fold **162**. As such, when the first, second, and third edge folds **160**, **162**, **164** are folded as discussed above, there is a gap (e.g., the gap **102**) between the first flange **26** and the first side wall **16**. The length **104** of the gap **102** is then approximately the difference between the length **182** of the left side **170** of the first edge fold **160** and the length **184** of the left side **176** of the second edge fold **162**. Further, the third edge fold **164** has a slanted left side **188** with respect to the crease **168**, forming an angle **186** (e.g., the angle **108** as illustrated in FIGS. **3** and **4**) therebetween. The slanted left side **188** is retracted from the left side **176** of the second edge fold **162** with a length **190** (e.g., the length (along the y-axis **58**) of the corner piece **91** as illustrated in FIGS. **3** and **4**).

As discussed with respect to FIG. **3**, the first upper ledge **25** and the third upper ledge **114** are substantially co-planar (e.g., on the horizontal plane **62**), and the first upper ledge **25** and the third upper ledge **114**, as well as the first base portion **24** and the third base portion **112**, join together substantially seamlessly about the line **120**. As such, the left side of the second bottom edge section **154** is designed to be substantially complimentary to the right side of the first bottom edge section **152**. For example, the second bottom edge section **154** includes three folds: a fourth edge fold **192**, a fifth edge fold **194**, and a sixth edge fold **196**. The fourth edge fold **192** borders the rest of the second section **144** about a crease **198**, the fifth edge fold **194** borders the fourth edge fold **192** about a crease **200**, and the sixth edge fold **196** borders the fifth edge fold **194** about a crease **202**. An angle **206** (e.g., the angle **124** as illustrated in FIG. **3**) is formed between a left side **204** of the fourth edge fold **192** and the crease **198**. The angle **206** is configured to be substantially complimentary to the angle **174**. That is, the sum of the angle **206** and **174** is substantially 90 degrees. An angle **210** formed between a left side **208** of the fifth edge fold **194** and the crease **202** is substantially the same as the angle **206** such that when the fourth and fifth edge folds **192**, **194** are folded

as discussed above, the left side **204** of the fourth edge fold **192** and the left side **208** of the fifth edge fold **194** are substantially aligned.

The fourth edge fold **192** has a length **212** along the z-axis **60** between the creases **198** and **200**, and the fifth edge fold **194** has a length **214** along the z-axis **60** between the creases **200** and **202**. The length **212** is greater than the length **214**, similar to the length **182** with respect to the length **184**, such that when the fourth, fifth, and sixth edge folds **192**, **194**, **196** are folded as discussed above, a gap may be formed between the third flange **116** and the rear wall **66**. This gap has a length (e.g., along the y-axis **58** illustrated in FIG. **3**) that is substantially the same as a length **218** between a right side **216** of the third edge fold **164** and the crease **146**. Also, the length **104** of the gap **102** between the first flange **26** and the first side wall **16** is substantially the same as a length **222** between a left side **220** of the sixth edge fold **196** and the crease **146**. As such, when the first, second, and third edge folds **160**, **162**, **164** as well as the fourth, fifth, and sixth edge folds **192**, **194**, **196** are folded as discussed above, the right side **216** of the third edge fold **164** and the left side **220** of the sixth edge fold **196** join one another substantially seamlessly. In some embodiments, the length **218** may be greater than the length of the gap between the third flange **116** and the rear wall **66** and/or the length **222** may be greater than the length **104** of the gap **102** between the first flange **26** and the first side wall **16**. As such when the first, second, and third edge folds **160**, **162**, **164** as well as the fourth, fifth, and sixth edge folds **192**, **194**, **196** are folded as discussed above, a gap may be formed between the right side **216** of the third edge fold **164** and the left side **220** of the sixth edge fold **196**. The third bottom edge section **156** may be designed similarly to the first bottom edge section **152** as described above with respect to the second bottom edge section **154** such that when folded, the second support portion **22** may join the third support portion **110** similarly to the way the first support portion **20** joins the third support portion **110** as described above.

While only certain features and embodiments have been illustrated and described, many modifications and changes may occur to those skilled in the art (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters (e.g., temperatures, pressures, etc.), mounting arrangements, use of materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter recited in the claims. The order or sequence of any process or method steps may be varied or re-sequenced according to alternative embodiments. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the disclosure. Furthermore, in an effort to provide a concise description of the exemplary embodiments, all features of an actual implementation may not have been described (i.e., those unrelated to the presently contemplated best mode of carrying out the disclosure, or those unrelated to enabling the claimed disclosure). It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation specific decisions may be made. Such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure, without undue experimentation.

The invention claimed is:

1. An air handling system, comprising:
- a casing structure formed from a cohesive sheet of material, wherein the casing structure comprises:
- a first side wall formed from a first section of the cohesive sheet of material;
- a first support portion extending inwardly from the first side wall, wherein the first support portion is formed from a folded portion of the first section of the cohesive sheet of material;
- a second side wall disposed substantially opposite the first side wall, wherein the second side wall is formed from a second section of the cohesive sheet of material; and
- a second support portion extending inwardly from the second side wall, wherein the second support portion is formed from a folded portion of the second section of the cohesive sheet of material and wherein the first and second support portions are configured to support a filter.

2. The air handling system of claim **1**, wherein each of the first and second support portions comprises a folded edge of the cohesive sheet of material.

3. The air handling system of claim **1**, wherein the first support portion comprises:
- a first fold that forms a base portion of the first support portion, the base portion extending inwardly from the first side wall;
- a second fold that forms an upper ledge of the first support portion, the upper ledge extending outwardly toward the first sidewall from an innermost edge of the first fold; and
- a third fold that forms a flange of the first support portion, the flange extending upwardly from the upper ledge.

4. The air handling system of claim **3**, wherein the flange is spaced from the respective side wall.

5. The air handling system of claim **3**, wherein the flange comprises a slanted edge.

6. The air handling system of claim **1**, wherein the casing structure comprises a back wall extending between the first side wall and the second side wall.

7. The air handling system of claim **6**, wherein the back wall comprises a third support portion extending inwardly from the back wall, wherein the first, second, and third support portions are configured to support the filter.

8. The air handling system of claim **7**, wherein the first, second, and third support portions each include protrusions that are substantially co-planar.

9. The air handling system of claim **1**, wherein the first and second support portions comprise respective flanges extending along the respective side walls.

10. The air handling system of claim **1**, wherein the first and second support portions each comprises:
- a first fold that forms a base portion extending inwardly from the respective side wall;
- a second fold that forms an upper ledge extending outwardly toward the respective sidewall from an innermost edge of the first fold; and
- a third fold that forms a flange extending upwardly from the upper ledge.

11. The air-handing system of claim **1**, comprising a door extending between an exposed edge of the first side wall and an exposed edge of the second side wall.

12. The air handling system of claim **1**, comprising:
- a first side angle attached to the first side wall above the first support portion; and
- a second side angle attached to the second side wall above the second support portion;
- wherein each of the first and second side angles comprises an angle base attached to the respective side wall and

an angle flange generally perpendicular to the angle base and extending inwardly from the respective side wall.

13. The air handling system of claim **12**, wherein each of the respective angle flanges comprises a tooth portion extending downwardly from the respective angle flange, wherein each tooth portion of the respective angle flange and the respective support portion form a channel configured to receive the filter therebetween.

14. A method of manufacturing a casing for an air handling system, comprising:

bending a unified sheet to form a first side wall, a back wall, and a second side wall of the casing such that the back wall extends between and is substantially perpendicular with the first and second side walls;

folding a portion of the first side wall to form a first support portion extending inwardly from the first side wall; and

folding a portion of the second side wall to form a second support portion extending inwardly from the second side wall, wherein the first and second support portions are configured to support a filter.

15. The method of claim **14**, comprising folding a portion of the back wall to form a third support portion extending inwardly from the back wall.

16. The method of claim **14**, wherein folding the portion of the first side wall comprises bending an edge of the first side wall inward about a first crease to form a base and bending the edge of the first side wall back onto itself about a second crease to form an upper ledge that is substantially parallel with the base.

17. The method of claim **16**, comprising bending the edge of the first side wall upward about a third crease to form a flange in a transverse orientation relative to the upper ledge.

18. The method of claim **17**, comprising positioning the third crease such that the flange is spaced from the respective side wall.

19. An air handling system, comprising:

a casing formed from a solid sheet of material;

at least three walls of the casing formed from portions of the solid sheet of material separated by creases that are formed substantially in parallel; and

edges of the walls that are folded to form projections extending inward relative to the casing, wherein the projections are configured to cooperate to retain a filter within the casing.

20. The air handling system of claim **19**, wherein the edges of the walls are folded in a boustrophedonic orientation.

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